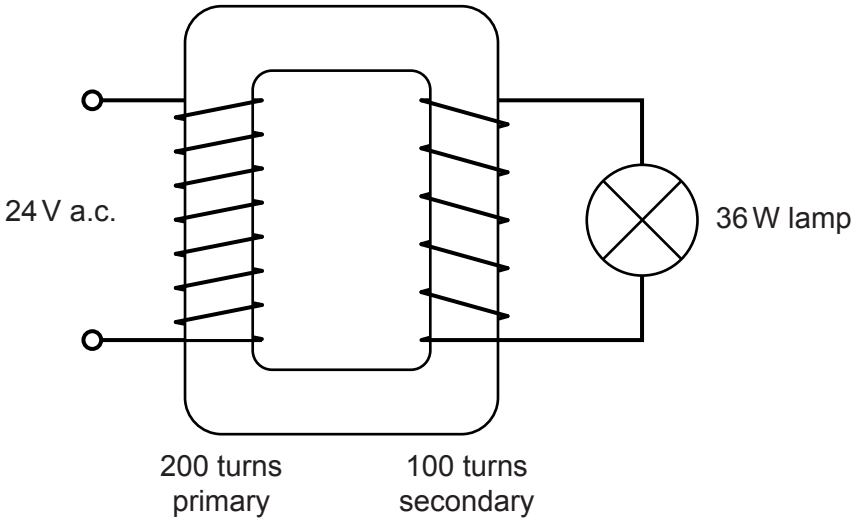
The following information is for use in questions **17** and **18**.

A transformer runs a 36.0 W lamp from a 24.0 V a.c. supply.



17 What is the current in the secondary coil?

A 1.5A

B 3.0A

C 4.0A

D 6.0A

Your answer ☐ **[1]**

18 What is the best estimate for the rate of change of flux in the transformer core?

A $0.12\,\text{Wb}\,\text{s}^{-1}$

B $0.12\,\text{T}\,\text{m}^{-2}\,\text{s}^{-1}$

C $12\,\text{Wb}\,\text{s}^{-1}$

D $12\,\text{T}\,\text{m}^{-2}\,\text{s}^{-1}$

Your answer ☐ **[1]**

20 At 300 K a process has an activation energy $E = 10kT$.

The temperature is raised to 330 K.

Which statement about the rate of the process is correct?

It will increase by

A 10% because temperature has increased by 10%.

B 10% because the mean square speed of the particles has increased by 10%.

C 9.1 times because $\frac{E}{kT} = \frac{3000k}{330k} = 9.1$.

D 2.5 times because $e^{\frac{-E}{kT}}$ has increased by $\frac{e^{-9.1}}{e^{-10}} = 2.5$ times.

Your answer ☐ **[1]**

21 Which of the following changes doubles the flux in a magnetic circuit?

1 doubling the permeance

2 doubling the current-turns

3 halving the circuit length

A 1, 2 and 3 are correct

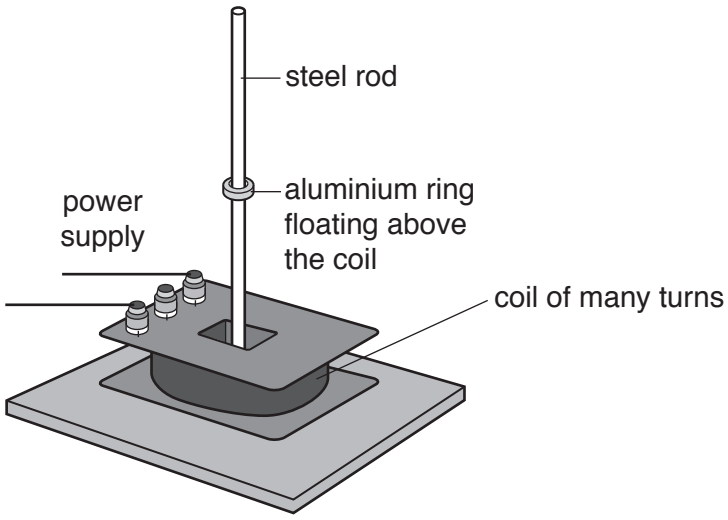
B only 1 and 2 are correct

C only 2 and 3 are correct

D only 1 is correct

Your answer ☐ **[1]**

22 An aluminium ring is free to move on a steel rod.
When the power supply is on, the ring floats.



Which of the following is correct?

A An a.c. or d.c. power supply can be used.

B The induced current in the ring is in the same direction as the current in the coil.

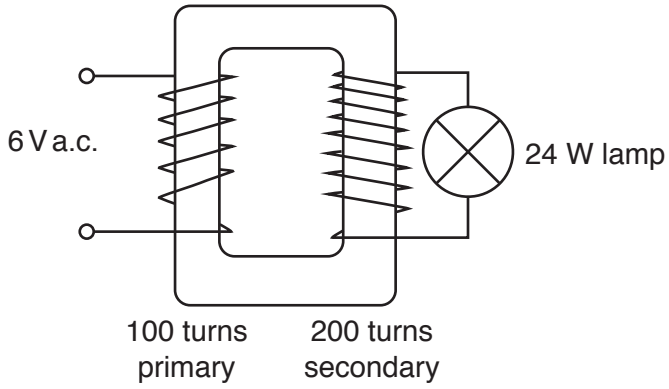
C The only purpose of the steel rod is to support the ring.

D When the ring is pushed down towards the coil more flux links it and the induced current increases.

Your answer ☐ **[1]**

The following information is for use in questions **23** and **24**.

A 6 V a.c. supply is connected to the 100 turn primary coil of an ideal transformer.
The 200 turn secondary coil runs a lamp which dissipates 24 W.



23 Which is the best estimate of the current in the secondary coil?

A $\frac{1}{4}$ A

B $\frac{1}{2}$ A

C 2 A

D 4 A

Your answer ☐ **[1]**

24 Which is the best estimate of the current in the primary coil?

A $\frac{1}{4}$ A

B $\frac{1}{2}$ A

C 2 A

D 4 A

Your answer ☐ **[1]**

3 This question is about the measurement of the **B**-field between a pair of slab magnets.
Fig. 3.1 shows the arrangement of the apparatus used in the experiment. It consists of a pair of slab magnets, with opposite poles facing one another, fixed onto a piece of U-shaped soft iron. The magnet assembly sits on top of an electronic balance. A rigidly fixed wire is shaped to carry a current I between the magnetic poles. The force created alters the balance reading.

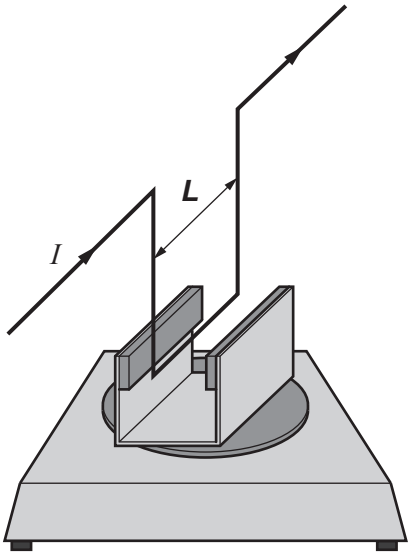


Fig. 3.1

Fig. 3.2 shows a section through the magnet assembly. The dot in the centre represents the wire.

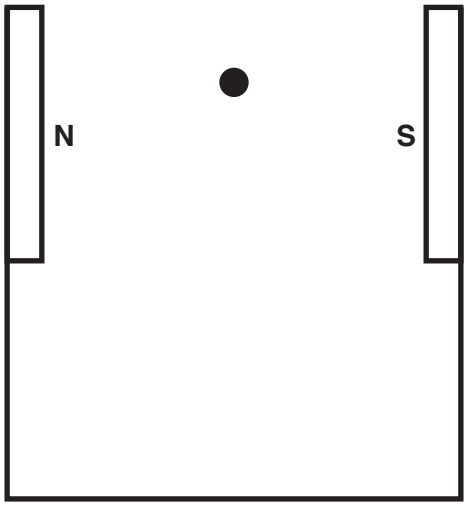


Fig. 3.2

(a) (i) Draw, on Fig. 3.2, at least **three** lines to represent the magnetic field in the region between the magnetic poles when the current in the wire is zero. **[2]**

(ii) Explain why the balance reading changes to a new value when the wire carries a current.

.....

.....

..... **[2]**

(b) The longest length of wire that could be used is 5.0 cm. The current I is varied and the change in the balance reading is recorded as shown in Fig. 3.3.

	Change in balance reading / g				
I / A	**Trial 1**	**Trial 2**	**Trial 3**	**Mean change / g**	**F / ×10^{-3} N**
0.5	0.08	0.05	0.06	0.06	0.59
1.0	0.14	0.16	0.16	0.15	1.5
1.5	0.22	0.20	0.23	0.22	2.2
2.0	0.31	0.29	0.31	0.30	2.9
2.5	0.38	0.39	0.35		
3.0	0.44	0.48	0.48		

Fig. 3.3

(i) Complete the table by calculating the mean change in balance reading and the corresponding values of force F for the last two current values.
$g = 9.8\,N\,kg^{-1}$ **[2]**

(ii) Use the table to determine the uncertainty in F. Explain your reasoning.

[2]

(iii) Plot the last two points from the table, Fig. 3.3, on the graph Fig. 3.4. Draw a line of best fit. **[2]**

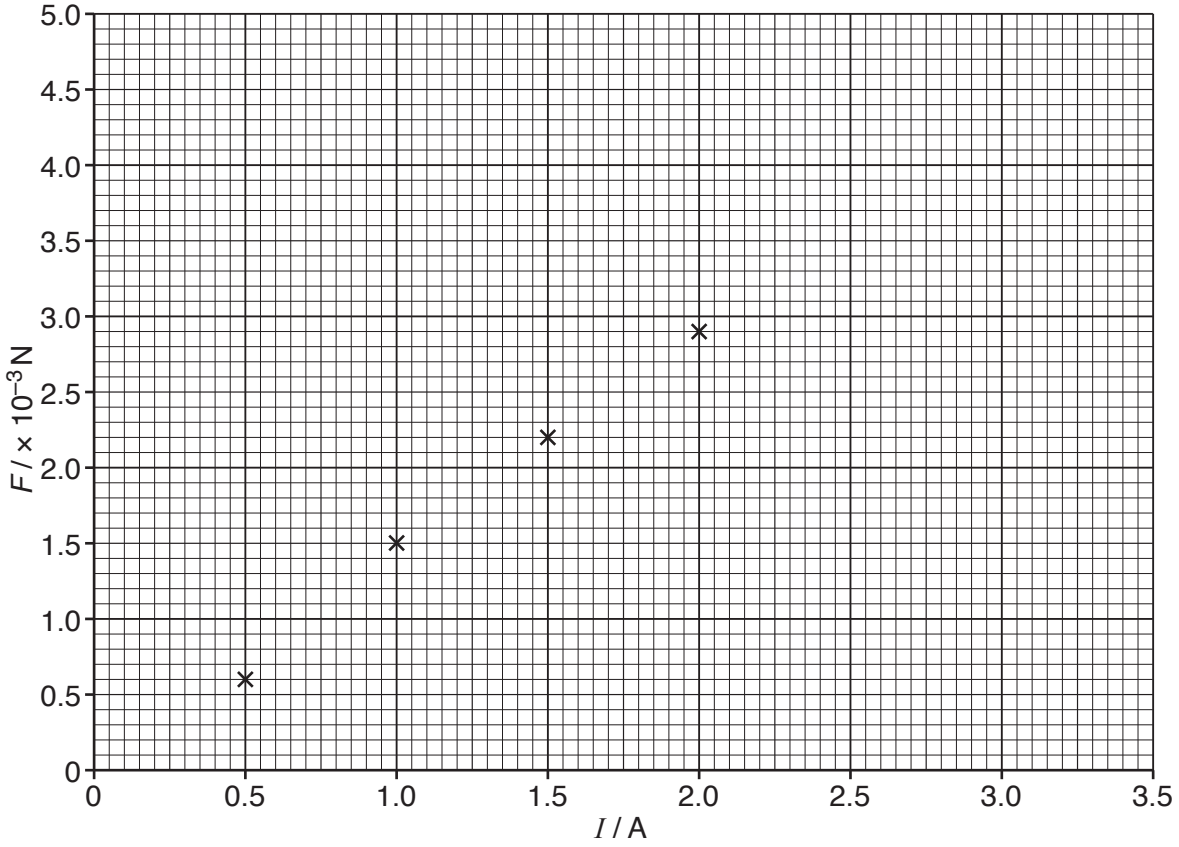


Fig. 3.4

(iv) Use the graph to estimate the value of the **B**-field between the faces of the slab magnets.

B = ... mT **[3]**